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FIRE SEPARATIONS

A.T. Hansen
Consulting Services
702 Roanoke St., Ottawa K1K 2G4

FIRE SEPARATIONS

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Prepared by A.T. Hansen Consulting Services

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A.T. Hansen, P. Eng.

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Preface

Fire separations are regulated by provincial and municipal building code agencies. This document is intended to be compatible with the 1990 edition of the National Building Code, intended to be used as a model by these agencies

It is the responsibility of the builder to be aware of the law under which he builds. This publication is not intended to be used as a substitute for such knowledge. Its role is purely instructive. While an attempt has been made to cover those features common to most regulations, it does not pretend to be complete. The relevant building regulations must be consulted for such details.

This publication is directed at smaller buildings covered by Part 9, of the NBC "Housing and Small Buildings". These are not more than 3 storeys in height with a floor area of not more than 600m^2 on any level. It is restricted to housing only.

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FIRE SEPARATIONS

Introduction

Fire separations must provide a "barrier" against the spread of fire. They must be continuous. If they contain doorways or have holes poked through them for ducts, piping or any other reason, steps must be taken to maintain the integrity of the separation. Self-closing fire doors, fire dampers and fire stopping are all devices to help maintain the continuity of the barrier.

The fire resistance of a fire separation is expressed in hours or minutes. During this period, the separation must remain intact and the unexposed side must not reach a temperature that would cause ordinary combustibles to ignite. If load-bearing, the assembly must continue to support the load for the rating period. Other criteria must also be met but these are the essential features. Doors and fire dampers are also fire rated, but are subject to different performance requirements.

Floor and roof assemblies are rated for fire exposure from the underside only. Interior walls, are rated for fire from each side. Since most interior walls are symmetrical, a rating from one side usually applies to both directions. Exterior walls, however, are rated for fire exposure on the inside only, the assumed origin of the fire.

Not all fire rated assemblies act as fire separations. A column, for example, may have to be fire rated to support a fire resistant floor. Obviously, it cannot act as a fire barrier. Building envelope components such as exterior walls and roofs may also be rated to provide stability in fire but they are not fire separations in a building code sense.

Fire separations are used for dividing a building into fire resisting compartments. They are also used to isolate known hazards such as fuel burning furnaces, electrical transformers, and communal storage areas. They also protect dwelling units from one another, and they protect the main escape routes.

Fire separations are also required to separate one property from another. Except in semi-detached and row houses, they are required to be built as fire walls. These are special types of fire separations that are also used to subdivide buildings into smaller "buildings" to take advantage of the less restrictive code requirements.

Fire Resistance of Masonry or Concrete

Masonry and concrete constructions are non-combustible, have a relatively high melting point and are able to continue to support loads at high temperatures. They can absorb large quantities of heat from fire and thus delay the rise in temperatures on the unexposed side. These properties make them excellent fire separations. When exposed to heat on one side, however, they tend to bow ; the thinner the wall, the more pronounced the bowing. This can make the wall unstable and lead to collapse. Their fire resistance therefore depends on both mass and thickness.

Frame Construction

In conventional frame construction the first line of defense is the gypsum board or plaster finish. Failure of these allows the fire to attack the supporting frame, eventually causing collapse. To obtain optimum benefits, therefore, the finish on the unexposed side should continue to resist fire until the framing can no longer support it.

In fire, the strength of gypsum board is greatly reduced as water is driven off and the paper surface is consumed. To counter these effects, a special type of board, known as "Type X", is produced. This is reinforced with glass or other suitable fibres.

In equal thicknesses, ceiling finishes fail sooner than wall finishes because the weakened board cannot support its weight in bending. To achieve the same rating, therefore, gypsum board on ceilings is generally thicker.

Insulation

Insulation can either add or subtract from the fire rating, depending in its location. While it resists the flow of heat, it also increases the temperature of the gypsum board causing it to weaken more rapidly.

On walls its strength is not critical. Even after wallboard failure, the insulation provides protection for the framing. Its net effect, therefore, is to increase the fire resistance rating. Since glass fibre has a relatively low melting point, its effect is small (5 minute increase). Insulation made from slag or rock, on the other hand, has a higher melting point and its effect is greater (15 minutes).

Ceilings are a different matter. If the ceiling board supports the insulation, this also falls away when the ceiling collapses, exposing the framing. To avoid downgrading the rating because of the insulation, closely spaced metal cross-furring is provided for its support (200mm o.c.). The ceiling is attached to every second member. The furring is wired to the framing to allow expansion in fire (Figure 1).

Fasteners

Metal fasteners conduct heat readily into the wooden members and cause charring around the fasteners. While not too significant in walls where they are not subject to withdrawal forces, it is important in ceilings. The minimum penetration into the wood varies with the magnitude of the rating (Figure 2). Fasâtenerlength is not as critical with metal supports, however.

Framing

As the temperature within the wall or ceiling space rises, the supporting members elongate. Steel studs may buckle if they are not free to expand, causing premature wallboard failure. A 12mm clearance is therefore provided. An allowance for expansion should also be provided for steel supporting members in ceilings as shown in Figure 1.

Supporting Structure

A structure supporting a fire rated assembly should have at least the same rating to avoid premature failure. A column or wall supporting a one hour floor, for example, should have a one hour rating as well. Where wooden joists are supported on a fire rated masonry wall, the ends of the joists have to be sloped back from the support (or fire cut) so that when they collapse they will pull away from the wall without damaging it (Figure 3).

Fire Stopping

Fires in concealed spaces can travel undetected. This may jeopardize escape and make fire fighting difficult. It also renders fire compartments ineffective in controlling fire. Unless the spaces are completely filled with insulation, fire stopping should be provided at strategic locations to restrict the spread of fire.

Spaces within walls should not communicate with concealed spaces above or below them. Attics, crawl spaces and floor spaces, therefore, should be blocked off from wall spaces. Exterior wall spaces should also be separated from interior wall spaces.

Many of these details are taken care of automatically through normal framing practices. The top and bottom wall plates act as fire stops and partition spaces are usually blocked off from exterior wall spaces by studs (Figure 4).

In balloon frame construction the stud spaces are continuous from one level to another and have to be blocked off at each level (Figure 5). This construction occurs in some split level houses and in preserved wood basements.

Spaces between furring or strapping can also allow fire spread. Vertical spaces should be blocked at each floor and ceiling level (Figure 3). Fire stops in horizontal spaces should not be more than

20m apart.

Overhanging eaves, exterior passageways, balconies and canopies can also create concealed spaces where fire can spread horizontally. Vertical fire stops are therefore required at horizontal intervals (20 m max.), and where the construction extends across the ends of fire separations, such as in row houses with gambrel type roofs (Figure 6).

Fire can enter attic spaces through the overhanging soffits or from openings in the attic ceiling. Loose electrical connections or overheated recessed lights can start fires within such spaces. To reduce the speed of fire travel, attics must be divided by fire stops at 20m intervals so that the individual open areas are less than 300m^2.

Stud, joist and furring spaces are usually fire stopped with the same material as the framing and furring. In larger spaces, such as attics and soffits, gypsum wallboard (12.7mm), plywood or waferboard (12mm) is commonly used. When pierced by piping, wiring or ducts, the openings around the penetrations must be tight fitting or sealed with a fire resisting material.

Openings into Concealed Spaces

Openings in gypsum board for recessed fixtures, duct diffusers or medicine cabinets can create hot spots on the unexposed side of the separation or may even initiate fire within the space.

Tightly fitted electrical switches, receptacles and lighting outlets can be tolerated since they are small and protected with electrical boxes. Electrical boxes on opposite sides of a wall separations should be staggered, however, to occur in different stud spaces. This also reduces sound transmission. For larger openings such as for registers and ducts, additional restrictions apply.

Although warm air heating ducts are seldom required to penetrate fire separations in residential buildings, individual exhaust ducts may. Ceiling openings for these can be unprotected if they are very small (130 cm^2 or 5 in. diam.). Openings up to 930 cm^2 (1 sq. ft.) can be used, however, if suitably protected with automatically closing metal flaps (Figure 7). All openings must lead directly to steel ducts with at least 100mm clearance above the ceiling.

Shafts

Vertical shafts for pipes, ducts and other services have to have sufficient fire resistance to prevent fire spread from floor to floor. The level of fire resistance depends on the use of the shaft (Table 1).

Apartment kitchens and bathrooms that do not have fans to exhaust directly outdoors, are usually served by ducts leading to a common exhaust shaft. These usually have a fan at the top of the shaft to keep the air flow upward. Individual fans for each unit can also be used if the ducts extend to the top of the shaft. No fire dampers are required where the duct enters the shaft provided steel ducts are used and extend upward in the shaft as shown in Figure 8.

Plastic Piping

Since plumbing vents are open at the top, they are under negative pressure whenever the outside air is colder than inside air. Fire can easily penetrate plastic vent pipes causing them to act as combustible chimneys, inducing fire across separations.

Plastic drain, waste and vent piping is not permitted in vertical shafts, within fire separations, or where any part of the DWV piping penetrates a floor separation. It is permitted on one side of a wall separation, however (Figure 9). Exceptions are permitted where tests show other arrangements to be safe.

Plastic water piping is not as serious a fire risk. Piping up to 25mm diameter may penetrate separations without restrictions. If fire compartments on both sides are sprinklered, plastic sprinkler piping of any size can be used.

Framing Around Openings

To resist warping forces on doors exposed to fire, the rough framing around them must be doubled, even in non-load bearing partitions. (Figure 10)

The installation of fire dampers also requires that the steel studs on either side of the rough opening be doubled, but single runners can be used to frame the top and bottom. The rough opening is lined with gypsum board to insulate the framing from the damper assembly. (Figure 11)

Automatic Closers and Latches

Many deaths have been caused when occupants, in their haste to escape from fire, have left their doors open, exposing the corridor to smoke and fire. While automatic closers are a minor nuisance, particularly for the physically impaired, the increased safety for others who share the building far outweighs the inconvenience.

Automatic closers are not sufficient by themselves to hold a door closed in a fire. The distortion of doors in fire allows the passage of fire around the edges of the door. To resist this, an effective latch is required with a sufficient throw to remain engaged as the door tries to distort. Hardware designed for fire door applications must be used.

Firewalls

The most severe requirements for fire separations apply to firewalls. These are required to separate one property from another (except in semi-detached and row houses). They are also used as a design feature to divide a large building into two or more smaller buildings to take advantage of reduced structural and fire safety requirements.

Unlike other fire separations, firewalls are required to be constructed from masonry or concrete. Although furring and paper covered gypsum board are allowed in addition to the masonry or concrete, they are not considered to contribute to its rating.

Firewalls must provide two hours of fire resistance, and be continuous from the footing to the top of the building. In frame construction, the firewall extends through the roof to form a parapet 150 mm above the roof (Figure 12). No combustible material such as siding, soffits or trim is allowed to extend across the ends of the wall. Combustible appendages close to the firewall such as balconies, stairs, canopies, or eave projections have to separated from similar appendages on the other side of the firewall (2.4m min.) to reduce the risk of fire spreading from one side to the other.

A firewall, however, must be stable in a fire for its entire rated period. Any roof or floor member supported by the firewall must have an equal rating so that it will not collapse before the firewall. Duct work or piping also has to be designed so that its collapse will not damage the firewall. The firewall must be able to withstand complete destruction on one side without affecting the other. One method is to design the wall as two independent wythes so that if one collapses, the other will remain intact.

Party Walls Between Houses

Although separations between semi-detached and row housing units on separate freehold properties can be combustible or non-combustible, they must provide at least one hour protection from the footing to the underside of the roof sheathing. Any space between the sheathing and the top of the wall must be stuffed with mineral wool or other suitable fire stopping material to prevent fire spread across the top of the wall (Figures 13 to 16).

Roof Framing Parallel to Party Wall

Where roof framing is parallel to the party wall, the fire separation can be simply extended up between the roof framing. Where masonry party walls are used, they can be built prior to the framing, shaped at the top to correspond to the roof slope and temporarily braced to resist wind until the roof is sheathed (Figure 13).

Wood framing instead of masonry can be used within the attic spaces to reduce costs. This can be framed as a conventional wall, or with a gable-end type roof truss with vertical members at 400 mm o.c. (Figure 14). Fink or Howe type trusses with diagonal web members should not be used, however, since the web members do not provide adequate wallboard support.

Roof Framing Perpendicular to Party Walls

Where a semi-detached house is designed to have a gable-end facing the street, the roof framing has to run at right angles to the party wall so that the ridge is directly above the wall. With trussed roofs,

monopitched trusses are used on either side of the party wall so that the protection can extend up to the ridge between the opposing trusses.

A masonry party wall can be extended up through the roof space in reduced thickness, creating a ledge on which the trusses are supported (Figure 15). Alternatively, a wood frame wall can be constructed above the party wall between opposing trusses (Figure 16).

Other Separations Between Dwelling Units

Where adjacent housing units are not on separate freehold properties, the fire separation can be reduced to 3/4 hours if the unit is on one level. In addition, such separations do not have to extend through the attic space if sufficient fire resistance is provided in the ceiling of the top storey. A ceiling membrane providing 1/2 hour protection is considered to be sufficient protection where the separating wall has a 3/4 hour rating. This can be attained with 15.9 mm thick type X gypsum board (Figure 17).

The combustible content of a two level unit is greater than for a one level unit. Multi-level dwellings, therefore, are required to have greater fire separations between units (one hour). In non-freehold units, the separation can be terminated at the uppermost ceiling if the ceiling membrane provides a one hour rating. Two layers of 15.9 mm thick type X gypsum board would be necessary to achieve this. This type of construction, however, allows more sound transmission between units.

Separations for Safe Exiting

Fire separations are necessary to protect escape routes such as public corridors and exit stairs (Table 1).

Passageways connecting exterior exit stairs are considered to be part of the exit and subject to the same separation requirements. If the passage way is more than 50% open to the outside air, however, and has an exit stair at each end, a fire rated separation between the passageway and the building is not considered necessary since the occupants have a smoke free choice of exits.

Isolating Known Hazards

Rooms for garbage storage, furnaces, incinerators and communal storage have a history of high fire incidence and are required to be isolated from the rest of the building by fire separations. (The floors of service rooms, however, are not required to be rated).

Common parking garages are also considered to be a fire threat and must be separated. A private garage that serves only the dwelling to which it is attached, however, is considered to be part of the dwelling and no rated separation is required. The separating construction has to be tight, however, to keep out gas and exhaust fumes. This can be accomplished with ordinary construction incorporating vapour barriers. Communicating doors have to be weather stripped and self-closing. Table 1 summarizes the locations required by the National Building Code to be protected with fire separations.

Table 1

Fire Separations Required to Isolate Critical Areas

Location	Required Rating of Separation	Required Door Rating
Private residential garage	0	0
Parking garage for up to 5 cars	1h	0.75h
Parking garage for more than 5 cars	1.5h	1h
Between dwellings (1 level)	0.75h	20 min
Between dwelling units (2 levels)	1h	20 min
Incinerator rooms	2h(1)	1.5h
Fuel fired furnaces & boiler rooms	1h(1)	0.75h
Temporary storage, combustible refuse	1h(1)(2)	0.75h
Other service rooms	1h(1)(3)	0.75h
Public storage lockers	1h(2)	0.75h
Public corridors	0.75h(4)	20 min
Exits / enclosure	0.75h(4)	20 min
Service shafts (other than refuse type)	0.75h	-
Refuse shafts		
Lower end protected with fire damper	1h	-
Not protected with fire damper	2h	-

(1) Floors are exempted.

(2) Can be reduced to 0.75h if floor assembly is permitted to be 0.75h or if storage room is sprinklered.

(3) Not required if equipment creates no hazard or if floor area is sprinklered.

(4) 1h if adjacent suite has 2 or more levels.

Determining Fire Resistance Ratings

The appendix of the NBC, contains a list of typical building assemblies for which ratings have been assigned. These show sound resistance as well as fire resistance, and are reproduced in Appendix A for reference. This is particularly useful for separations between dwelling units where both sound and fire resistance are regulated.

Building product associations also publish information on fire resistance and sound ratings, and these are also useful sources of information (8). In addition, commercial testing agencies such as Underwriters Laboratories of Canada, and Warnock-Hersey have published extensive listings of products they have tested, and these may be purchased from the appropriate agency (1), (2).

Fire resistance can also be calculated. Chapter 2 of the Supplement to the NBC provides a methodology for calculating fire resistance ratings of common constructions. Appendix B is based on Section 2.3 of the NBC Supplement relating to frame construction. Appendix C gives a number of examples of how to calculate fire resistance.

Where mineral wool is needed to achieve the required fire resistance in Appendix A, it must be of rock or slag fibre weighing 1.22kg/m^2 of wall (0.25psf). If it is only for sound resistance, however, its mass is not too important and none is specified. A minimum insulation mass is therefore required in some walls and not in others. In Appendix B, excerpted from the NBC Supplement, the minimum mass needed to give credit for glass fibre wall insulation is 0.6kg/m^2.

Fire Doors and Dampers

Doors and dampers in fire separations do not have to meet the same performance requirements as solid walls. To distinguish these from other ratings, they are referred to as fire performance ratings. Since the door frame as well as the hinges and latching hardware are considered as part of the closure, they also must be tested and rated.

The fire performance ratings for doors and dampers are generally permitted to be less than the ratings for the separation in which they occur (Table 1). This is partly traditional, but it also recognizes the practical difficulty of achieving higher ratings for these assemblies. Doors and dampers constitute a relatively small portion of the separation, and since they are non-structural, a reduction from the overall rating is not considered to be critical.

A construction standard has been developed to ensure that solid core wood doors will provide a 20 minute rating without the need to test individual doors (3). Doors meeting this standard are marked to identify the manufacturer and the rating. If the door is certified by one of the national certifying agencies, the identifying logo of the agency is also shown.

The 20 minute fire door standard should not be confused with the general standard for exterior doors. Exterior doors do not have to be rated, and the standard to which they are made does not necessarily produce a 20 minute door.

Frames are also required to be identified. The only exception to this rule is for 38 mm thick wood frames which are permitted for use with 20 minute doors. These have been shown by experience to be adequate and need no further identification.

Since steel frames tend to warp and twist when exposed to fire they must be solidly anchored into the surrounding masonry or rough framing. Standards specify this (4) and installation instructions are normally available from the manufacturer. With steel stud walls, a gypsum board filler piece is needed to insulate the top of the horizontal runners from a metal door frame to prevent excessive distortion in fire (Figure 18).

Certifying agencies publish listings of tested products together with relevant information concerning installation.

Fire Spread Around Separations

Fire separations will be ineffective if fire can travel around them. This can occur at the exterior of the building where windows in one fire compartment expose the windows in another.

They are considered to be an exposure threat if the angle between the intersecting walls is less than 135 deg.. This can occur where units in a semi-detached or row house are stepped back from one another (Figure 19). To reduce this risk, the windows in adjacent units have to be spaced at least 1.2 m apart.

The spacing of windows on either side of a fire wall is treated differently due to the special nature of this type of separation. The windows on either side of the fire wall must be at least one metre apart, even if they are in the same plane. If exterior walls intersect at an angle of less than 135 degrees, the distance between windows must be calculated according to NBC Article 3.2.3.14.

Fire can also spread through common attic spaces where an overhanging eave is exposed to fire from a window below. Openings for attic ventilation provide ready access for fire if they are close to the window. Thin combustible soffit coverings also provide little resistance. Unless the space between the top wall plate and the roof sheathing is fire stopped in the area near windows, protective measures are necessary to reduce the exposure danger if more than 2 housing units share a common attic space (Figure 20).

Although fire can also spread from storey to storey when windows are close to one another, this is considered to be an acceptable risk in housing because of the light fire load. The provision of balconies above such windows or a vertical separation between them should be kept in mind as ways for reducing this risk, however, even though not required.

Fire Separations to Provide Sound Resistance

The separation between dwellings must provide sound resistance as well as fire resistance. Sound resistance is expressed in terms of sound transmission class (or STC) ratings. The higher the number, the more sound resistant the assembly is perceived to be. A voice heard through a wall with an STC rating of 25 is perceived to be twice as loud as through a wall with an STC rating of 50.

A simple stud wall with gypsum wallboard on each side would have a rating of about 33 or 34, about the same as a simple joisted floor system. The National Building Code requires a minimum STC rating of 50 between dwelling units and 55 between dwelling units and noisy equipment areas. Normal frame construction must therefore be modified to achieve this level of resistance.

By supporting the wall or ceiling membrane on one side on one set of supports, and the membrane on the other side on another set, most of the sound transmission through the framing is eliminated (Figure 21). This can also be achieved using resilient metal channels designed for this purpose to attach the wallboard. The use of steel studs has a similar effect. If a sound deadening layer such as glass fibre is used in the cavity between the two membranes, the transmission through the air gap is also significantly reduced. (Insulation in simple stud walls, however, is largely ineffective since most of the sound is transmitted directly through the framing rather than through the air spaces). Increasing the wallboard thickness also increases the overall sound resistance.

Cracks or holes can significantly reduce sound resistance, just as they can render a fire separation ineffective. The higher the STC rating, the greater will be the reduction in the rating. Gaps beneath walls and around service penetrations have to be caulked to prevent any air paths through the assembly. Electrical boxes should be tightly fitted to the surrounding finish, and offset at least a full stud space from those on the other side. This spacing allows the insulation to absorb most of the sound before it reaches the other opening.

Construction that allows sound to find an easy flanking pathway around the perimeter of the separation may also allow fire to circumvent the separation. Measures to reduce the sound transmission at these flanking paths usually assist in improving fire performance as well. Figure 22 shows details of how such flanking paths can be overcome. Similarly, constructions shown in Figures 13 to 16 are acoustically superior to that in Figure 17.

Sound that travels throughout the building as vibrations in the structure are known as impact sounds. These are commonly caused by footsteps or furniture movement. Impact sound transmission is not restricted in Canadian codes although most systems designed to regulate airborne noise also provide a fair resistance to impact noise. The use of soft floor coverings such as carpeting, however, is very effective in reducing impact sounds.

Glass in Fire Separations

Ordinary glass exposed to fire will break and fall away within minutes when exposed to fire. Although ways have been developed to protect such glass with sprinklers (11), it is more typically reinforced with steel wire mesh when used in fire separations. Although this does not prevent the glass from cracking, the wire holds it together allowing it to function as a barrier to fire for up to one hour. To remain in place, however, it has to be mounted in a substantial steel frame that provides a deep glazing stop on both sides to hold the glass in place (Figure 23).

Thermal expansion in fire restricts the maximum size of individual glass panels to 1.4 m in length and width and 0.84m^2 in area. For large expanses of glass, structural mullions have to be provided as well so that the area between mullions is 7.5 m^2 or less.

Glass used in fire doors as viewing panels is subject to different restrictions. Since doors have to be tested and rated, the maximum size and glazing details are determined on the basis of performance tests.

Fire from windows can expose an exterior exit doorway if it is at an angle to the window. The smaller the angle, the greater the exposure potential. Where this possibility occurs, windows within 3 m of the door should be glazed with wired glass to prevent the flames from interfering with escape.

Windows can also expose exterior stairs and prevent their use in fire. Windows within a horizontal distance of 3 m, or a vertical distance of 5 m above and 10 m below such stairs must be glazed with wired glass (Figure 24).

Summary

The main purpose of fire separations is to create fire compartments in buildings to contain known hazards, or to protect housing units from each other. In apartment buildings where escape routes are shared, fire separations are used to safeguard evacuation in fire.

Party walls between separately owned semi-detached and row housing units can be combustible or non-combustible.. Other walls that divide one property from another are required to be constructed as fire walls. These are non-combustible separations that provide sufficient stability to allow for the complete destruction of the building on one side without affecting the other side.

Since fire separations are required to provide barriers to fires, they must have all significant openings protected with self-closing devices and have all cracks or holes fire stopped.

The ratings for fire separations can be determined from the National Building Code, or from its Supplement. Such ratings can also be found in the published listings of the major testing agencies and from trade associations.

Fire can spread in spaces concealed within walls and floors, as well as attic and roof spaces. These must be fire stopped wherever horizontal and vertical spaces communicate, and elsewhere to limit the total size of the space.

Fire separations between adjacent dwellings must also act as sound barriers. Defects such as holes or cracks that reduce sound resistance can also reduce the resistance to fire. Sound can also find flanking paths around sound separations the same way fire can short circuit fire separations.

The use of glass causes special problems in fire resistant assemblies. Its use is therefore controlled so that the escape of the occupants will not be jeopardized.

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APPENDIX A

Tables A-9.10.3.A. and A-9.10.3.B.

Fire and Sound Resistance of Walls, Floors, Ceilings and Roofs

(Excerpts from the National Building Code of Canada, 1990)

A-9.10.3.1. Fire and Sound Resistance of Building Assemblies. The following tables may be used to select building assemblies for compliance with Article 9.10.3.1. and Subsection 9.11.2. However, these tables are provided only for the convenience of Code users. Assembles not listed in these tables are equally acceptable provided their fire and sound resistance can be demonstrated to meet the above-noted requirements on the basis of tests described in 9.10.3.1. and 9.11.1. or by using the data in Chapter 2 of the Supplement to the NBC 1990.

Table A-9.10.3.A.

Fire and Sound Resistance of Walls

Type of Wall	No.	Description	Finish on Each Side[1]	Fire-Resistance Rating	Typical Sound Transmission Class[2]
Hollow concrete block (normal weight aggregate)	1	140-mm block	None[3]	1 h	48
	2	Same as 1	B	2 h	51
	3	Same as 1, with both surfaces fastened directly, or both on metal resilient channels, or both on metal resilient channels with absorptive material[4]	A	2 h	47
	4	Same as 1, with metal resilient channels and absorptive material on one side[4]	A	1.75 h	51
	5	Same as 1, with 38-mm x 38-mm wood strapping and absorptive material on both sides[4]	A	2 h	57
	6	190-mm block	None[3]	1.5 h	50
	7	190-mm block	B	2 h	50

Table A-9.10.3.A. (Cont'd)

Fire and Sound Resistance of Walls					
Type of Wall	No.	Description	Finish on Each Side[1]	Fire-Resistance Rating	Typical Sound Transmission Class[2]
	8	Same as 6, with both surfaces fastened directly, or both on metal resilient channels, or both on metal resilient channels with absorptive material[4]	A	2.5 h	49
	9	Same as 6, with metal resilient channels and absorptive material on one side[4]	A	2.5 h	53
	10	Same as 6, with 38-mm x 38-mm wood strapping on at least one side	A[6]	2.5 h	53
	11	Same as 6, with 38-mm x 38-mm wood strapping and absorptive material on both sides[4]	A[6]	2.5 h	59
	12	Same as 6, with 50-mm metal Z-bars (or 38-mm x 38-mm wood strapping plus metal resilient channels) and absorptive material on both sides[4]	A	2.5 h	64
	13	Same as 6, with studs (65-mm steel or 38-mmx 64-mm wood) and absorptive material on both sides[4]	A[6]	2.5 h	70
	14	Same as 6, with metal resilient channels and absorptive material on one side	D (finish one side only)	2.5 h	55
Concrete	15	150 mm	None[3]	3 h	55
	16	200 mm	None[3]	4 h	5

Table A-9.10.3.A. (Cont'd)

Fire and Sound Resistance of Walls

Type of Wall	No.	Description	Finish on Each Side[1]	Fire-Resistance Rating	Typical Sound Transmission Class[2]
Interior wood stud single row	17	38-mm x 89-mm studs 400 mm o.c.	C	1 h	34
	18	38-mm x 89-mm studs 400 mm o.c., with absorptive material [5]	A[6]	45 min	36
	19	Same as 18 [4]	C	1 h	36
	20	Same as 18, with resilient metal channels on at least one side [5]	A[6]	45 min	48
	21	Same as 18, with resilient metal channels on at least one side [4]	C	1 h	48
	22	Same as 18, with resilient metal channels on at least one side [4]	D	1 h	54
Interior wood stud two rows staggered on 38-mm x140-mm plate	23	Two rows 38-mm x 89-mm studs, each set 400 or 600 mm o.c., staggered on common 38-mm x 140-mm plate, with absorptive material on both sides [5]	A[6]	45 min	50
	24	Same as 23, but with absorbtive material on one side [4]	C	1 h	51
	25	Same as 23, but with absorbtive material on one side [4]	D	1 h	54
Interior wood stud two rows on separate plates	26	Two rows 38-mm x 89-mm studs, each set 400 or 600 mm o.c. on separate 38-mm x 89-mm plates set 25 mm apart, with absorptive material one side [4]	C	1 h	53
	27	Same as 26, but absorptive material on both sides [5]	A[6]	45 min	57

Table A-9.10.3.A. (Cont'd)

Fire and Sound Resistance of Walls

Type of Wall	No.	Description	Finish on Each Side[1]	Fire-Resistance Rating	Typical Sound Transmission Class[2]
	28	Same as 26, but absorptive material on both sides [4]	C	1 h	57
	29	Same as 26, but absorptive material on both sides [4]	D	1 h	63
Exterior wood stud	30	38-mmx 89-mm or 38 mm x 140-mm studs spaced up to 600 mm o.c., mineral fiber with mass of at least 1.22 kg/m², wall sheathing and siding	A [6] (interior side)	45 min	N/A
	31	Same as 30	C or D (interior side)	1 h	N/A
Non-loadbearing steel studs	32	90-mm steel studs spaced up to 600 mm o.c.	C	45 min	39
	33	Same as 32, with absorptive material in cavity [4]	C	1 h	45
	34	Same as 32, with absorptive material in cavity [4]	D	1 h	53

Addendum to Table A-9.10.3.A.:

(1) Finishes designated by letter as follows:
A = 12.7-mm gypsum board with joints taped and filled,
B = 12.7-mm gypsum-sand plaster,
C = 15.9-mm special fire-resistant Type X gypsum board conforming to CSA A82.27, "Gypsum Board Products" with joints taped and filled, and
D = two layers of 12.7-mm gypsum board with joints taped and filled.

(2) Sound ratings listed are based on the most reliable laboratory test data available. Results of specific tests may differ slightly because of measurement precision and minor variations in construction details. Constructions with sound transmission class ratings of 50 or more require acoustical sealant applied around electrical boxes and other openings, and at the junction of intersecting walls and floors, except intersection of walls constructed of concrete or solid brick.

(3) Sound ratings require no discernible cracks or voids. For concrete blocks, surfaces must be sealed by at least 2 coats of paint or other surface finish described in Section 9.29 to prevent sound leakage.

(4) Sound absorptive material includes fibre processed from rock, slag, or glass, and must fill at least three-quarters of the cavity space to provide the listed STC.

(5) Absorptive material required to achieve fire-resistance rating and STC rating and includes mineral fibre processed from rock or slag with mass of at least 1.22 kg/m² and completely filling the wall cavity.

(6) Regular gypsum board shall be installed so that all edges are supported.

Table A-9.10.3.B.

Fire and Sound Resistance of Floors, Ceilings and Roofs

Type of Assembly	No.	Description	Finish on Ceiling [1]	Fire Resistance Rating	Typical Sound Transmission Class [2]
Concrete slabs	1	90-mm reinforced concrete with 20-mm minimum cover over reinforcing steel	None [3]	1 h	48
	2	130-mm reinforced concrete with 25-mm minimum cover over reinforcing steel	None [3]	2 h	52
Open web steel joists	3	Open web steel joists at 400 mm o.c. with minimum 50-mm thick concrete deck, ceiling secured to furring channels spaced not more than 600 mm o.c. wired to underside of joists [4]	C	45 min	53
Wood floor joists spaced not more than 400 mm o.c.	4	Subfloor of 19-mm T&G lumber or 15.5-mm plywood, waferboard or strandboard, ceiling finish attached to metal resilient channels spaced at 200 mm o.c., absorptive material in cavity [4]	C	45 min	48
or	5	Same as 4, with additional layer of 11 mm sanded plywood, waferboard or strandboard on floor	C	45 min	50
Wood floor trusses [5] spaced not more than 600 mm o.c.	6	19-mm gypsum-concrete topping (at least 34 kg/m^2) on subfloor of 19-mm T&G lumber or 15.5-mm plywood waferboard or strandboard	D	45 min	52
	7	Same as 6	E	1 h	52
	8	Same as 6, with absorptive material in cavity [4], ceiling finish attached to metal resilient channels spaced at 200 mm o.c.	C	45 min	55

Table A-9.10.3.B. (Cont'd)

Fire and Sound Resistance of Floors, Ceilings and Roofs					
Type of Assembly	No.	Description	Finish on Ceiling [1]	Fire Resistance Rating	Typical Sound Transmission Class [2]
	9	38-mm lightweight concrete topping (at least 70 kg/m²) on subfloor of 19-mm T&G lumber or 15.5-mm plywood, waferboard or strandboard	D	45 min	54
	10	Same as 9	E	1 h	56
	11	Same as 9, except ceiling finish attached to metal resilient channels	C	45 min	57
	12	Same as 9, with absorptive material in cavity [4], ceiling finish attached to metal resilient channels spaced at 200 mm o.c.	C	45 min	60
Rating provided by membrane only	13	Supporting members spaced not more than 600 mm o.c.	C	30min	N/A
	14	Same as 11	E	1 h	N/A
Wood roof trusses spaced not more than 600 mm o.c.	15	38-mm x 89-mm framing members with metal connector plates not less than 1 mm thick with teeth not less than 8 mm in length	C	45 min	N/A

Addendum to Table A-9.10.3.B.:

(1) Finishes designated by letter as follows:
C = 15.9-mm special fire-resistant Type X gypsum board conforming to CSA A82.27, "Gypsum Board Products" with joints taped and filled,
D = two layers of 12.7-mm gypsum board with joints taped and filled, and
E = two layers of 15.9-mm special fire-resistant Type X gypsum board with joints taped and filled.

(2) Sound ratings listed are based on the most reliable laboratory test data available. Results of specific tests may differ slightly because of measurement precision and minor construction details. Constructions with sound transmission class ratings of 50 or more require acoustical sealant applied around electrical and other openings, and at the junction of intersecting walls and floors, except intersection of walls constructed of concrete or solid brick.

(3) Sound ratings assume no cracks or voids.

(4) Sound absorptive material includes fibre processed from rock, slag or glass and must fill at least three-quarters of the cavity space to provide the listed STC.

(5) Floor trusses have 38-mm × 89-mm wood framing members with metal connector plates not less than 1 mm thick with teeth not less than 8 mm in length.

APPENDIX B

Wood and Steel Framed Walls, Floors and Roofs

(Excerpts from the Supplement to the National Building Code of Canada, 1990)

2.3 Wood and Steel Framed Walls, Floors and Roofs

2.3.1. The fire-resistance rating of walls, floors and roofs, incorporating wood, steel, light-gauge steel members and open-web steel joists for ratings up to and including 1.5 h shall be determined by this Subsection, except as described in Tables 2.3.H. and 2.3.I.

2.3.2. The ratings in this Subsection apply to both loadbearing and non-loadbearing wood framed walls, to non-loadbearing steel framed walls and to loadbearing floors and roofs. Loadbearing conditions shall be as defined in CAN4-S101, "Standard Methods of Fire Endurance Tests of Building Construction and Materials."

2.3.3. The fire-resistance rating of a framed assembly shall be calculated by adding the time assigned in Article 2.3.4. for the membrane on the fire-exposed side plus the time assigned in Article 2.3.5. for the framing members plus the time assigned in Article 2.3.10. for additional protective measures such as the inclusion of insulation or the reinforcement of a membrane. The assigned times in Articles 2.3.4., 2.3.5. and 2.3.10. are not intended to be construed as the fire-resistance ratings of the individual components of an assembly. These assigned times are the individual contributions to the overall fire-resistance rating of the complete assembly.

2.3.4. The fire-resistance rating of a framed assembly depends on the time during which the

Table 2.3.A.
Forming Part of Article 2.3.4.

Time Assigned to Wallboard Membranes on Fire Exposed Side	
Description of Finish	Time min
12.5 mm fibreboard	5
8.0 mm Douglas Fir plywood phenolic bonded	5
11.0 mm Douglas Fir plywood phenolic bonded	10
14.0 mm Douglas Fir plywood phenolic bonded	15
9.5 mm gypsum wallboard	10
12.7 mm gypsum wallboard	15
12.7 mm Type X gypsum wallboard	25
15.9 mm gypsum wallboard	20
15.9 mm Type X gypsum wallboard	40
Double 9.5 mm gypsum wallboard	25
12.7 mm and 9.5 mm gypsum wallboard	35
Double 12.7 mm gypsum wallboard	40
Double 12.7 mm gypsum wallboard	50 (1)
Double 12.7 mm Type X gypsum wallboard	80 (2)
4.5 mm asbestos cement and 9.5 mm gypsum wallboard	40 (2)
4.5 mm asbestos cement and 12.7 mm gypsum wallboard	50 (2)
Composite 3 mm asbestos cement on 11 mm fibreboard	20
Column 1	2

Notes to Table 2.3.A.:

(1) Wire mesh with 1.57 mm diam wire and 25 mm by 25 mm openings must be fastened between the two sheets of wallboard.

(2) Applies to non-loadbearing steel framed walls only.

(3) Values shown apply to walls only.

membrane on the fire-exposed side remains in place. Tables 2.3.A. and 2.3.B. list the times which have been assigned to membranes on the fire-exposed side of the assembly based on their ability to remain in place during fire tests. This is not to be confused with the fire-resistance rating of the membrane, which shall also take into account the rise in temperature on the unexposed side of the membrane.

2.3.5. When the membrane on the fire-exposed side of a framed assembly falls off, there is a brief period of time before structural failure occurs during which the studs or joists are exposed directly to flame. Table 2.3.C. lists the times which have been assigned to the framing members based on the time involved between failure of the membrane and collapse of the assembly.

2.3.6. Interior vertical fire separations shall be rated for exposure to fire on each side, and it is assumed, therefore, that membrane protection will be provided on both sides of the assembly. In the calculation of the fire-resistance rating of such an assembly, however, no contribution to fire resistance should be assigned for a membrane on the non-fire-exposed side, since this membrane may fail when the structural members fail.

2.3.7. When an exterior wall assembly is required to be rated from the interior side only, such wall assemblies may have an outer membrane consisting of sheathing and exterior cladding combinations listed in Table 2.3.D. or may be any membrane that is assigned a time for contribution to fire resistance of at least 15 min in Table 2.3.A. or 2.3.B.

2.3.8. In the case of a floor or roof, the standard test provides only for testing for fire exposure from below. Floor or roof assemblies of wood, light-gauge steel members or open-web steel joist framing shall have an upper membrane consisting of a subfloor and finish floor conforming to Table 2.3.E. or any other membrane that has a contribution to fire resistance of at least 15 min in Table 2.3.A.

2.3.9.

(1) Insulation used in the cavities of a wood floor assembly will not reduce the assigned fire-resistance rating of the assembly provided:

(a) the insulation is preformed of rock, slag or glass fibre conforming to CSA A101, "Thermal Insulation, Mineral Fibre, for Buildings" having a mass of not more than 1.1 kg/m^2 and is installed adjacent to the bottom edge of the framing member, directly above steel furring channels,

(b) the gypsum wallboard ceiling membrane is attached to

(i) wood trusses in conformance with Sentence 2.3.11.(2) by way of steel drywall furring channels spaced not more than 400 mm o.c., and the channels are secured to each bottom truss member with a double strand of 1.2 mm galvanized steel wire, or

Table 2.3.B.
Forming Part of Article 2.3.4.

Time Assigned to Lath and Plaster Protection on Fire Exposed Side, min[1]					
Type of Lath	Type of Plaster Finish				
	Plaster Thickness mm	Portland Cement and Sand[2] or Lime and Sand	Portland Cement, Sand and Asbestos Fibre (1.4 kg/bag of cement)	Gypsum and Sand or Gypsum Wood Fibred	Gypsum and Perlite or Gypsum and Vermiculite
Wood lath	13	5	10	20	—
12.5 mm fibreboard	13	—	—	20	—
9.5 mm gypsum lath	13	—	—	35	55
9.5 mm gypsum lath	16	—	—	40	65
9.5 mm gypsum lath	19	—	—	50	80[1]
Metal lath	19	20	35	50	80[1]
Metal lath	23	25	40	65	80[1]
Metal lath	26	30	50	80	80[1]
Column 1	2	3	4	5	6

Notes to Table 2.3.B.:

(1) The values shown for these membranes have been limited to 80 min because the fire resistance ratings of framed assemblies derived from these Tables shall not exceed 1.5 h.

(2) For mixture of portland cement-sand plaster, see Sentence 1.7.3.(2).

Table 2.3.C.
Forming Part of Article 2.3.5.

Time Assigned for Contribution of Wood or Light Steel Frame	
Description of Frame	Time assigned to Frame min
Wood studs 400 mm o.c.	20
Steel studs 400 mm o.c.	10
Wood floor and wood roof joists 400 mm o.c.	10
Open web steel joist floors and roofs with ceiling supports 400 mm o.c.	10
Wood roof and wood floor truss assemblies 600 mm o.c.	5
Column 1	2

Table 2.3.D.
Forming Part of Article 2.3.7.

Membrane on Exterior Face of Wood or Steel Stud Walls	
Sheathing	Exterior Cladding
16 mm T & G lumber 7.5 mm exterior grade plywood 12.7 mm gypsum board	Lumber siding Wood shingles and shakes 6 mm plywood exterior grade 6 mm hardboard Metal siding Stucco on metal lath Masonry veneer
None	9.5 mm exterior grade plywood
Column 1	2

Table 2.3.E.
Forming Part of Article 2.3.8.

Flooring or Roofing over Wood, Cold Formed Steel Members or Open-Web Steel Joists			
Type of Assembly	Structural Members	Subfloor or Roof Deck	Finish Flooring or Roofing
Floor	Wood or steel joists and wood trusses	12.5 mm plywood or 17 mm T & G softwood	Hardwood or softwood flooring on building paper Resilient flooring, parquet floor felted synthetic fibre floor coverings, carpeting, or ceramic tile on 8 mm thick panel-type underlay Ceramic tile on 30 mm mortar bed
	Steel joists	50 mm reinforced concrete or 50 mm concrete on metal lath or formed steel sheet, or 40 mm reinforced gypsum-fibre concrete on 12.7 mm gypsum wallboard	Finish flooring
Roof	Wood or steel joists and wood trusses	12.5 mm plywood or 17 mm T & G softwood	
	Steel joists	50 mm reinforced concrete or 50 mm concrete on metal lath or formed steel sheet or 40 mm reinforced gypsum-fibre concrete on 12.7 mm gypsum wallboard	Finish roofing material with or without insulation
Column 1	2	3	4

(ii) wood joists by way of drywall or resilient steel furring channels spaced not more than 400 mm o.c. in conformance with Sentences 2.3.11.(2) and (3), and

(c) a steel furring channel is installed midway between each furring channel mentioned in Clause (b) to provide additional support for the insulation.

2.3.10. Preformed rock or slag fibre insulation provides additional protection to wood studs by shielding the studs from exposure to the furnace and thus delaying the time of collapse. The use of reinforcement in the membrane exposed to fire also adds to the fire resistance by extending the time to failure. Table 2.3.F. shows the time increments that may be added to the fire resistance if these features are incorporated in the assembly.

2.3.11.

(1) The values shown in Tables 2.3.A., 2.3.B. and 2.3.H. apply to membranes supported on framing members spaced in conformance with Table 2.3.C.

(2) Wood studs and wood roof and floor framing members are assumed to be not less than 38 mm by 89 mm. Wood trusses are assumed to

Table 2.3.F.
Forming Part of Article 2.3.10.

Time Assigned for Additional Protection	
Description of Additional Protection	Fire Resistance min
Add to the fire-resistance rating of wood stud walls if the spaces between the studs are filled with preformed insulation of rock or slag fibres conforming to CSA A101, "Thermal Insulation, Mineral Fibre, for Buildings" and with a mass of not less than 1.22 kg/m² of wall surface (1)	15
Add to the fire-resistance rating of non-loadbearing wood stud walls if the spaces between the studs are filled with preformed insulation of glass fibres conforming to CSA A101, "Thermal Insulation, Mineral Fibre, for Buildings" and having a mass of not less than 0.6 kg/m² of wall surface	5
Add to the fire-resistance rating of plaster on gypsum lath ceilings if 0.76 mm diam wire mesh with 25 mm by 25 mm openings or 1.57 mm diam diagonal wire reinforcing at 250 mm o.c. is placed between lath and plaster	30
Add to the fire-resistance rating of plaster on gypsum lath ceilings if 76 mm wide metal lath strips are placed over joints between lath and plaster	10
Add to the fire-resistance rating of plaster on 9.5 mm thick gypsum lath ceilings (Table 2.3.B.) if supports for lath are 300 mm o.c.	10
Column 1	2

Note to Table 2.3.F.:
(1) There is no test data to justify the 15 min additional protection for preformed glass fibre insulation.

consist of wood chord and web framing members and connector plates fabricated from at least 1 mm thick galvanized steel with projecting teeth at least 8 mm long. Dimensions for dressed lumber are given in CSA 0141, "Softwood Lumber."

(3) The allowable spans for wood joists listed in Part 9 of the National Building Code of Canada 1990 are provided for floors supporting specific occupancies.

(4) Except as otherwise required in this Chapter, metal studs shall be of galvanized steel not less than 0.5 mm thick.

(5) The thickness of plaster finish shall be measured from the face of gypsum or metal lath.

(6) Gypsum wallboard installed over framing or furring shall be installed so that all edges are supported, except that 15.9 mm thick Type X gypsum wallboard may be installed horizontally with the horizontal joints unsupported.

(7) Except as required in Article 2.3.9., resilient or drywall furring channels may be used to attach a gypsum wallboard ceiling membrane to a floor or roof assembly provided the channels are of galvanized steel not less than 0.5 mm thick and are placed at a spacing of not more than 600 mm o.c. perpendicular to the framing members with an overlap of not less than 100 mm at splices and a minimum end clearance between the channels and walls of 15 mm.

2.3.12.

(1) Except as provided in Sentences (2) to (6), the fastening of lath and plaster or gypsum wallboard finish shall conform to CSA A82.30, "Interior Furring, Lathing and Gypsum Plastering" or CSA A82.31, "Gypsum Board Application."

(2) Where membrane protection referred to in Tables 2.3.A., 2.3.B. and 2.3.H. is applied to steel framing or furring, fasteners shall penetrate at least 10 mm through the metal.

(3) Except as provided in Sentences (4) and (5), where membrane protection referred to in Tables 2.3.A., 2.3.B. and 2.3.H. is applied to wood framing or furring, minimum fastener penetrations into wood members shall conform to Table 2.3.G. for the time assigned to the membrane.

(4) Where membrane protection is applied in 2 layers, the fastener penetrations described in Table 2.3.G. shall apply to the base layer. Fasteners for the face layer shall penetrate at least 20 mm into wood supports.

Table 2.3.G.
Forming Part of the Article 2.3.12.

Minimum Fastener Penetrations for Membrane Protection on Wood Frame, mm						
Type of Membrane	Assigned Contribution of Membrane to Fire Resistance, (1) min					
	5-25	30-35	40	50	55-70	80
Single layer	20	29	32	—	—	—
Double layer	20	20	20	29	35	44
Gypsum or fibreboard lath	20	20	23	23	29	29
Column 1	2	3	4	5	6	7

Note to Table 2.3.G.:

(1) Assigned contributions of membranes to fire resistance are determined in Tables 2.3.A., 2.3.B. and 2.3.H.

(5) Where adhesives are used to attach the face layer of gypsum wallboard in a double layer application for walls, the top and bottom of the face layer shall be secured to the supports by mechanical fasteners having lengths as required in Sentences (2) and (4) and spaced not more than 150 mm o.c. for wood supports and not more than 200 mm o.c. for steel supports.

(6) In a double layer application of gypsum wallboard on wood supports, fastener spacing shall conform to Section 9.29 of the National Building Code of Canada 1990.

2.3.13.

(1) Where a beam is included with an open-web steel joist or similar construction and is protected by the same continuous ceiling, the beam is assumed to have a fire-resistance rating equal to that assigned to the rest of the assembly.

(2) The ratings in this Supplement assume that the construction to which the beam is related is a normal one and does not carry unusual loads from the floor or slab above.

2.3.14. Metal studs in walls required to have a fire-resistance rating shall be installed with not less than 12 mm clearance between the top of the stud and the top of the runner to allow for expansion in the event of fire. Where attachment of the studs is necessary for alignment purposes during erection, such attachment shall be made to the bottom runners only.

2.3.15. Where the fire-resistance rating of a ceiling assembly is to be determined on the basis of the membrane only and not of the complete assembly, the ratings may be determined from Table 2.3.H., provided no openings are located within the ceiling membrane.

Table 2.3.H.
Forming Part of Article 2.3.15.

Fire-Resistance Rating for Ceiling Membranes	
Description of Membrane	Fire-Resistance Rating, min
9.5 mm gypsum wallboard and 12.7 mm gypsum wallboard	30
Double 12.7 mm gypsum wallboard	30
15.9 mm Type X gypsum wallboard with at least 75 mm mineral wool batt insulation above wallboard	30
19 mm gypsum-sand plaster on metal lath	30
Double 14.0 mm Douglas Fir plywood phenolic bonded	30
Double 12.7 mm Type X gypsum wallboard	45
25 mm gypsum-sand plaster on metal lath	45
Double 15.9 mm Type X gypsum wallboard	60
32 mm gypsum-sand plaster on metal lath	60
Column 1	2

2.3.16.

(1) Except as provided in Article 2.3.15., where a floor or roof assembly of combustible construction is assigned a fire-resistance rating on the basis of this Subsection and incorporates a ceiling membrane described in Table 2.3.A. or 2.3.B., the ceiling membrane may be penetrated by openings leading to ducts within concealed spaces above the membrane provided:

(a) the assembly is not required to have a fire-resistance rating in excess of 1 h,
(b) the area of any openings does not exceed 930 cm² (see Sentence (2)),
(c) the aggregate area of openings does not exceed 1 per cent of the ceiling area of the fire compartment,
(d) the depth of the concealed space above the ceiling is not less than 230 mm,
(e) the dimension of any opening does not exceed 310 mm,
(f) supports are provided for openings with any dimension exceeding 150 mm where framing members are spaced greater than 400 mm o.c.,
(g) individual openings are spaced not less than 2 m apart,
(h) the ducts above the membrane are sheet steel and are supported by steel strapping firmly attached to the framing members, and
(i) the clearance between the top surface of the membrane and the bottom surface of the ducts is not less than 100 mm.

(2) Where an individual opening permitted in Sentence (1) exceeds 130 cm² in area, it shall be protected by

(a) a fire stop flap conforming to Subsection 5.3, or
(b) thermal protection above the duct consisting of the same materials as used for the ceiling membrane, mechanically fastened to the ductwork and extending 200 mm beyond the opening on all sides (see Figure 2.3.(a)).

2.3.17.

(1) Except as permitted in Article 2.3.15., where a floor or roof assembly of noncombustible construction is assigned a fire-resistance rating on the basis of this Subsection, and incorporates a ceiling membrane described in Table 2.3.A. or 2.3.B., the ceiling membrane may be penetrated by openings leading to ducts located within concealed spaces above the membrane provided:

(a) the area of any opening does not exceed 930 cm² (see Sentence (2)),
(b) the aggregate area of openings does not exceed 2 per cent of the ceiling area of the fire compartment,
(c) the dimension of any opening does not exceed 400 mm,
(d) individual openings are spaced at least 2 m apart,
(e) openings are located at least 200 mm from major structural members such as beams, columns or joists,
(f) the ducts above the membrane are sheet steel and are supported by steel strapping firmly attached to the framing members, and
(g) the clearance between the top surface of the membrane and the bottom surface of the duct is at least 100 mm.

(2) Where an individual opening permitted in Sentence (1) exceeds 130 cm² in area, it shall be protected by

(a) a fire stop flap conforming to Subsection 5.3, or
(b) thermal protection above the duct consisting of the same materials as used for the ceiling membrane, mechanically fastened to the ductwork and extending 200 mm beyond the opening on all sides (see Figure 2.3.(a)).

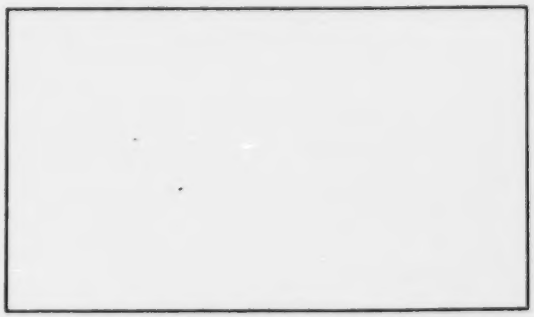

Figure 2.3.(a) Thermal protection above a duct

APPENDIX C

Sample Calculations for Fire Resistance

SAMPLE CALCULATIONS

Although the Supplement to the NBC can be used to calculate the fire resistance for an array of building assemblies, it is not as convenient for the builder to use as the tables in the appendix to the NBC (Appendix A). This is especially true where sound resistance is also required, since this is not covered in the Supplement. The following examples are provided, however, as a guide to those who may wish to make such calculations.

Example 1

Suppose a wood frame wall with one hour fire resistance is to be built between two housing units.

1. According to Table 2.3.C. in Appendix B, wood stud framing at 400mm o.c. is assumed to remain in place for 20 minutes.
2. If glass fibre insulation is used in the stud space to improve the sound resistance, the contribution of the insulation according to Table 2.3.F. is assumed to be 5 minutes.
3. The additional fire resistance to be provided by the wall finish therefore is 60-20-5 or 35 minutes. According to Table 2.3.A. this could be achieved with one layer of 15.9mm type X gypsum board (40 min.) or two layers of ordinary gypsum board (12.7mm and 9.5mm pm each side (35 min.).
4. Instead of using the Supplement, the tables in Appendix A can be used to select from wall No. 22, 24, 25, 26, 28, or 29.

Example 2

A wall with a 2 hour rating is required around an incinerator room. It is proposed to construct it with steel studs and gypsum wallboard.

1. The method described in Section 2.3 of the Supplement (Appendix B) cannot be used to estimate ratings greater than 1.5 hours (Article 2.3.1).
2. The constructions in Table A-9.10.3.A. (Appendix A) cannot be used since the ratings for the steel stud assemblies do not exceed 1 hour.
3. The list of assemblies tested by Underwriters Laboratories of Canada (or ULI in the US) and Warnock-Hersey should be consulted to see if there is an appropriate one listed with the required rating (see Reference 1 and 2). Appropriate assemblies can also be found in Reference 8.

Example 3

A wood floor with conventional wood joists is to provide a 3/4 hour fire separation between two single level dwelling units in an apartment building.

1. According to Table 2.3.C. in the Supplement (Appendix B), solid wood joists have a fire endurance of 10 min.
2. No credit is given to insulation, but if it is used, then Article 2.3.9. must be followed for the attachment of the ceiling, the density of insulation, and its support.
3. The additional protection required to be provided by ceiling finish is 45-10 or 35 min.
4. According to Table 2.3.A. of the Supplement (Appendix B), one layer of 15.9 mm type X wallboard would be adequate protection.
5. The minimum subfloor and finish floor on the unexposed side would have to conform to Table 2.3.E. of the Supplement.
6. Fastener penetration would have to conform to Table 2.3.G.
7. If Table A.9.10.3.B. is used (Appendix A), the floor designs can be selected directly from any one of those in assemblies No. 4 to 12 in the table.

Example 4

A low rise apartment building is designed with a wood trussed roof. All units are single level. How should fire separations on the top storey be designed?

1. In a typical apartment building, the fire separations run in two directions - both parallel to and at right angles to the framing. It is not practical, therefore, to extend the separation up through the roof trusses. The easier solution is to terminate the separation at the uppermost ceiling and design the ceiling membrane as a fire separation.

2. Since apartment units are on one level, only a 3/4 hour separation is required between units and between the corridor and exits (Table 1).

3. For a 3/4 hour wall, the ceiling membrane must have at least a 1/2 hour rating.

4. According to Table 2.3.H. in Appendix B, any of the listed finishes could be used. Fastener penetration would have to conform to Table 2.3.G.

5. If Table A-9.10.3.B. is used (Appendix A), assembly No.13 could be used to satisfy this rating.

It will be noted that the ratings in the Supplement for the ceiling membrane (Table 2.3.H.) are different from those where the assembly has a floor or roof deck on the opposite side (Table 2.3.A.). In the latter case, the rating is an allowance for the time the ceiling board will stay in place, while the former it is a measure of the fire resistance of the board itself, and allows for a temperature rise limit on the unexposed side.